



# **LAMP Convection and Lightning**

**Jess Charba  
Fred Samplatsky  
Phil Shafer**

**Meteorological Development Laboratory  
National Weather Service, NOAA**

**Updated September 06, 2013**

# **LAMP Lightning and Convection Products: Review**

- **Operational lightning products**
  - Prob of  $\geq 1$  CTG lightning strikes in 20-km boxes during 2-h period
  - Yes/no lightning forecasts derived from probs
  - Implemented in 2006
  - Field use of forecasts has been small
- **Experimental convection products**
  - Prob of radar reflect  $\geq 40$  dBZ or  $\geq 1$  CTG strike; otherwise same as for lightning
  - Convection potential (4 categories) derived from probs
  - Produced experimentally since April 2011
  - FAA makes extensive use of probs
- **Experimental lightning products (op replacement)**
  - Same predictand as for operational lightning probs
  - Lightning potential (derived as for convection)

# **LAMP Lightning and Convection Products: Review (cont)**

- **Predictor inputs for old lightning**
  - Radar and lightning obs
  - Advected surface variables
  - Lightning climatology
  - GFS MOS lightning probs
  
- **Predictor inputs for convection**
  - Same as for old lightning except –
    - Convection climatology
    - GFS MOS convection probs
    - NAM MOS convection probs
    - Dynamic interaction between GFS and NAM MOS probs
  
- **Predictor inputs for new lightning**
  - As for convection

# **Presentation Topics**

- **Preliminary verification based on objective scoring of lightning and convection prototype forecast products**
- **Case study examination**
- **Findings**

# Preliminary Verification

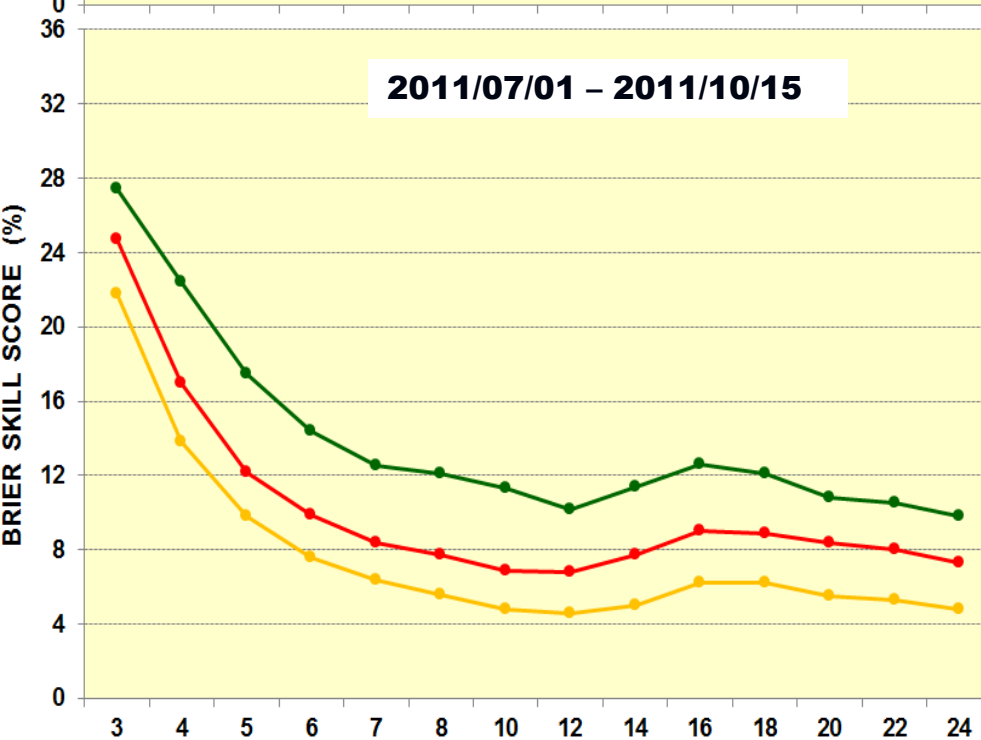
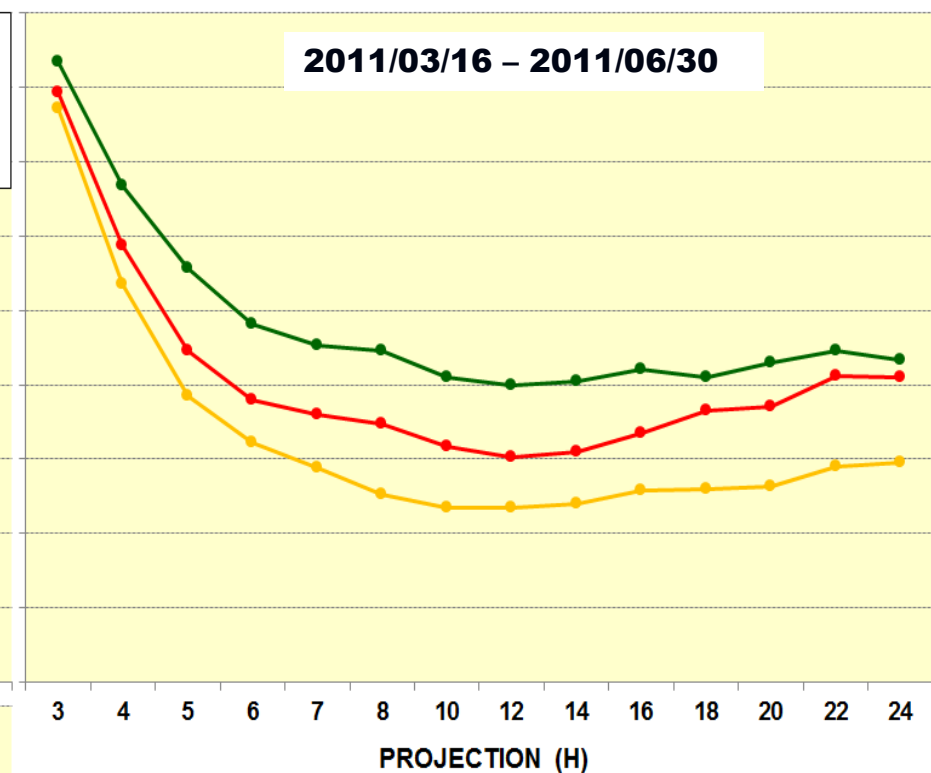
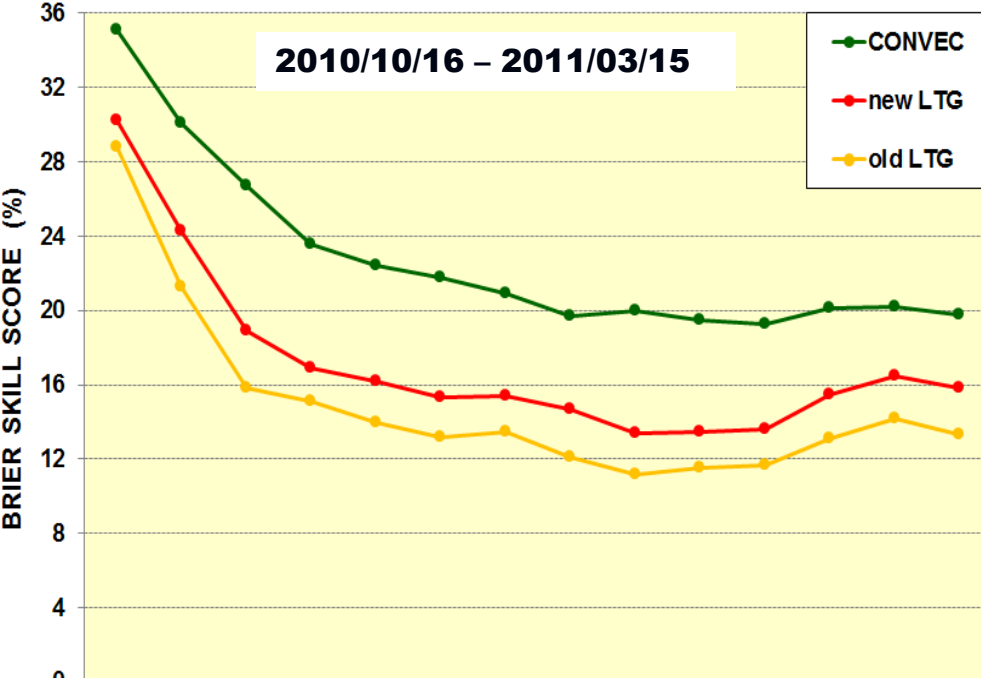
## ■ Brier Score improvement on climatology

- Convection prob vs convection obs
- **New lightning prob vs lightning obs \***
- **Old lightning prob vs lightning obs \***
- Sample = Oct 2010 – Oct 2011
- 06z LAMP cycle

## ■ Threat Score and bias

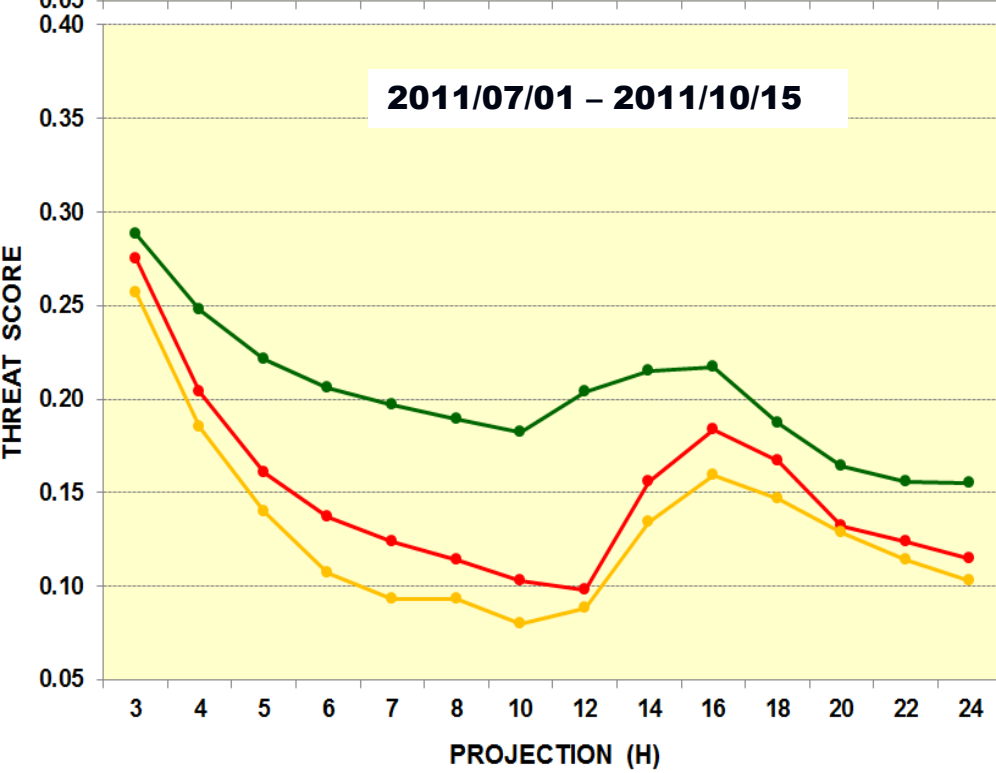
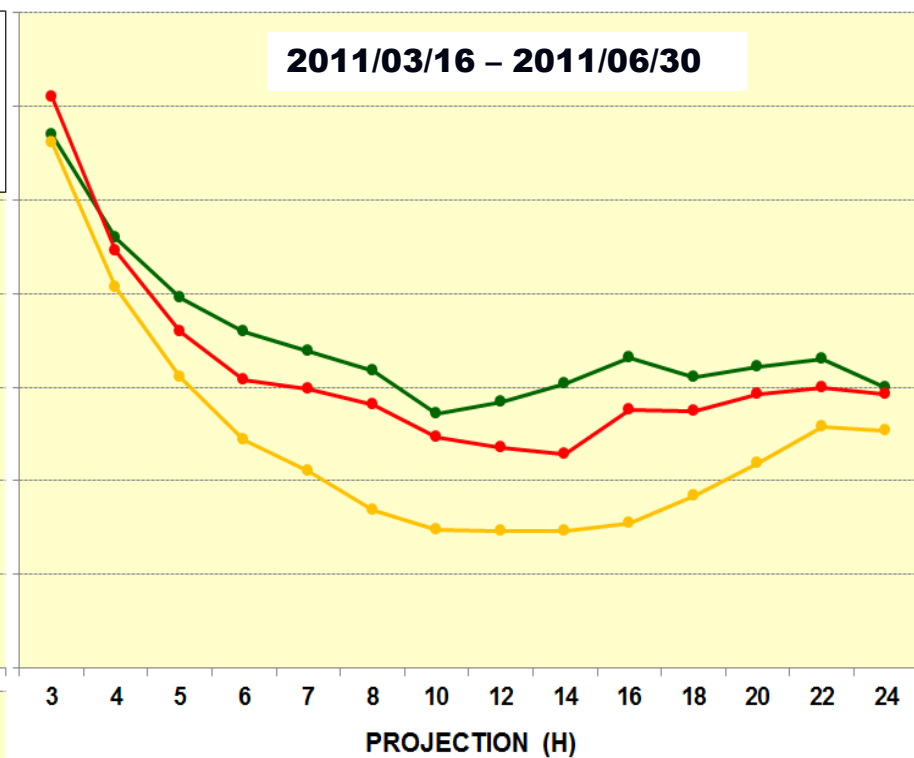
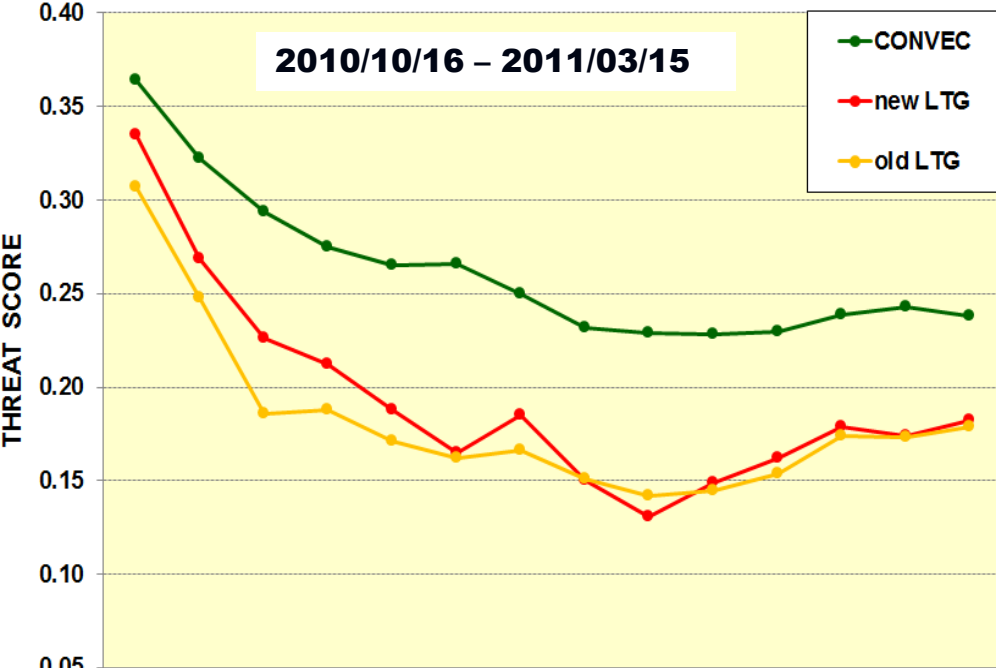
- Yes/no medium + high potential
  - Convection
  - **New lightning \***
  - **Old lightning categorical \*** (has same bias property as yes/no medium + high potential)
- Yes/no low + above potential; yes/no high potential
  - Convection and new lightning only
- Same sample as above

\* Same predictand

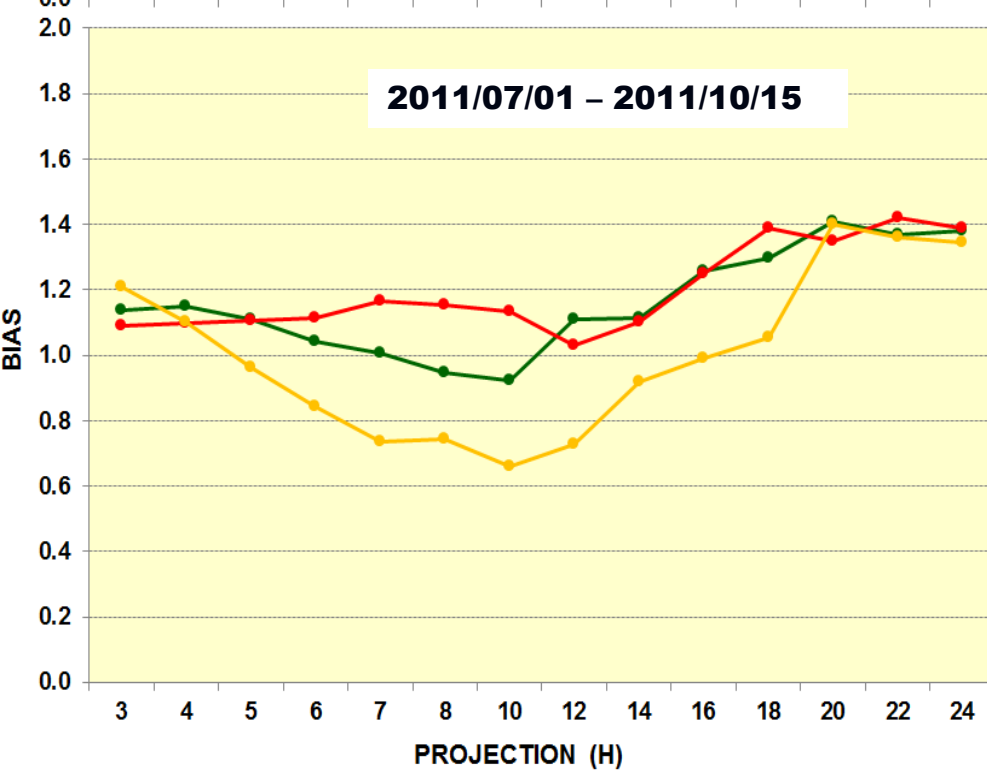
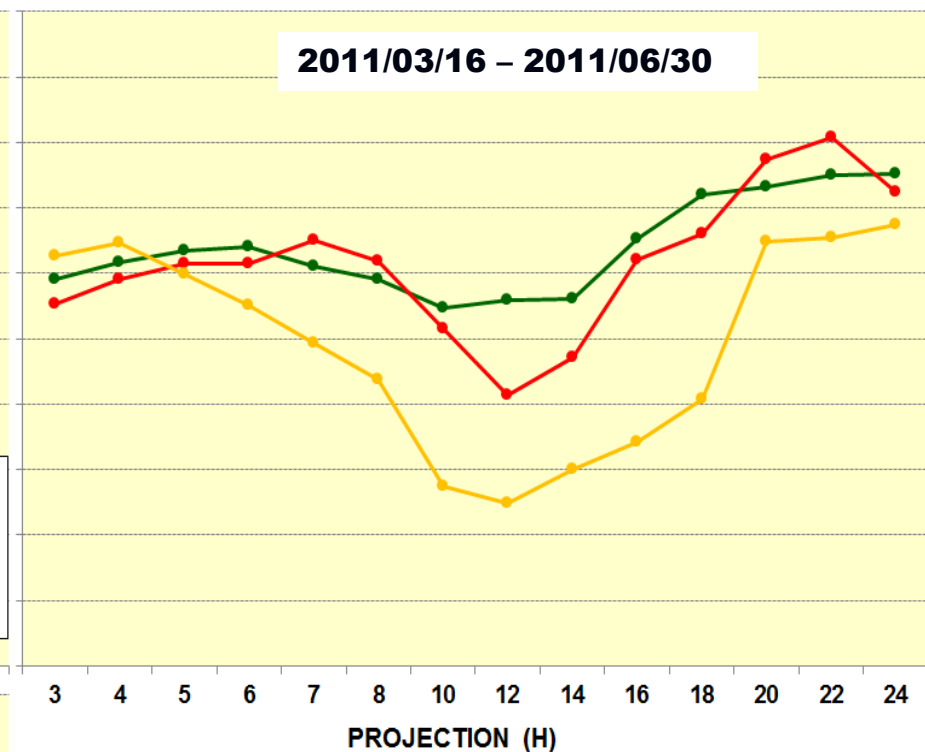
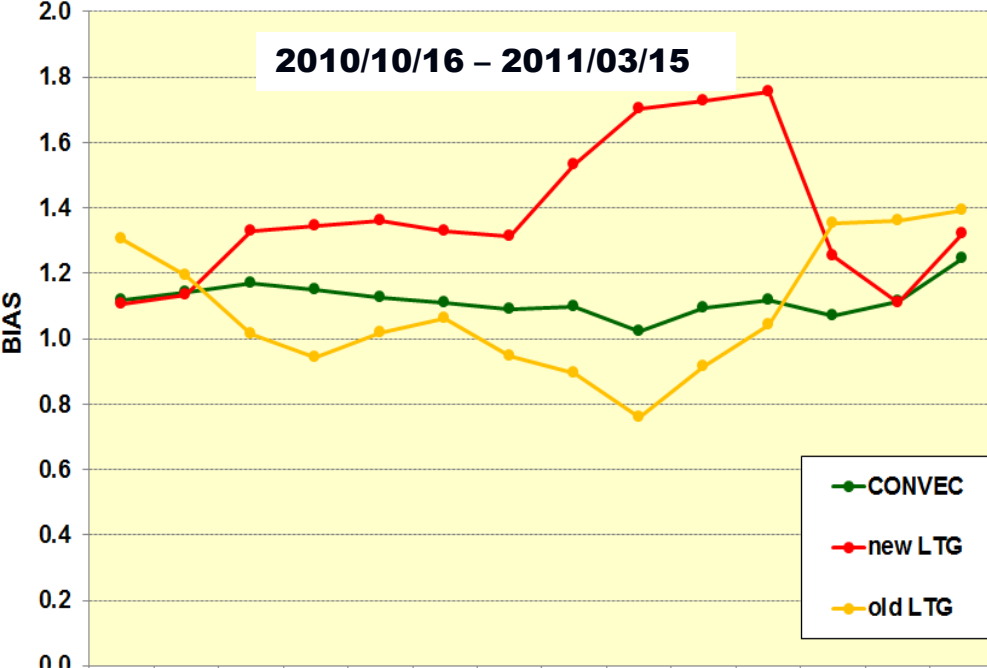


**Brier Score improvement on climatology (Brier Skill Score) for LAMP convection (CONVEC), new lightning (new LTG), and old/operational lightning (old LTG) probs for 0600 UTC cycle.**

**Note: Scores for convection vs lightning not comparative.**

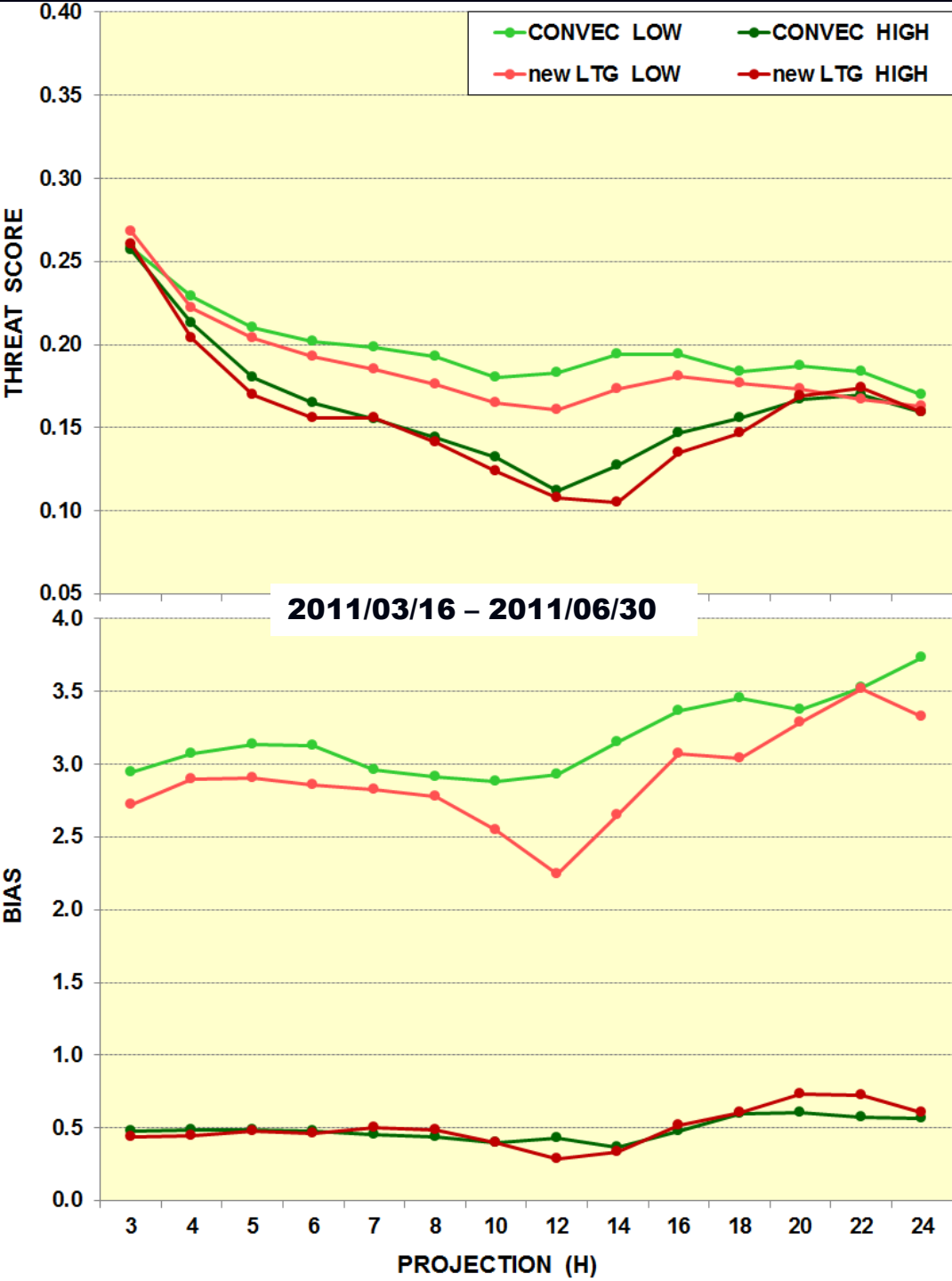


**Threat Score for y/n medium + high potential (categorical for old/operational LTG) for LAMP 0600 UTC cycle. Legend as before. Note: Scores for convection vs lightning not comparative.**



**Bias for y/n medium + high potential (categorical for old/operational LTG) for LAMP 0600 UTC cycle. Legend as before.**





**Threat score (upper) and bias (lower) for low + above (LOW) and high potential (HIGH) for LAMP 0600 UTC cycle (convection and new lightning only). Legend as before. **Note:** Threat score for convection vs lightning not comparative.**

# Comparative Forecasts/Obs Maps

**URL = <http://www.mdl.nws.noaa.gov/~glmp/fred/gwcases.php>**

## ■ **Description of 3 x 3 panel of web maps**

- **Upper left = convection probability (%)**
- **Upper center = new lightning probability (%)**
- **Upper right = old lightning probability (%)**
  
- **Middle left = convection potential (4 categories)**
- **Middle center = new lightning potential (4 categories)**
- **Middle right = old lightning categorical (2 categories)**
  
- **Lower left = obs convection occurrence (yes/no)**
- **Lower center = reported number of CTG lightning strikes**
- **Radar reflectivity (6 levels; convection threshold is level 3 \*)**

**\* Convection occurrence specified as  $\geq 40$  dBZ reflectivity or  $\geq 1$  CTG lightning strikes**

# Features in Cases

- 1. 2010/11/30** -- shows huge contrast in predicted coverage of convection (large) versus predicted coverage of lightning (small) for a cool season case, which verified quite well.
- 2. 2011/02/28** – Predicted coverage of convection and lightning is more similar than in previous case. Also the predicted coverage of both is consistent with obs, where lightning decays more rapidly than convection for the long forecast projections (late evening hours).
- 3. 2011/04/25** -- Features include capturing spatial detail of lightning in early projections, higher new lightning probs than old lightning probs for mid-projections, and some inability to predict fine scale convection and lightning development along southwest flank of squall line (in northeast TX) during midnight – 2 am period (longest projections).
- 4. 2011/04/26** – Next day forecast captures convection in E TX, higher new vs old lightning probs beyond 6-h projection, nice ability to forecast the decay of convection and lightning during early afternoon hours in southern states, and then explosive development in TX, AR, and LA during late afternoon and continuing to 2 am.

# Features in Cases (cont)

- 5. 2011/04/27** – shows very similar probs among all three products for earliest projections, much more rapid drop-off in probs with increasing projection for old vs new lightning, explosive predicted development of convection and lightning during late afternoon - early evening and continuing to 2 am.
- 6. 2011/05/01** – Again, very similar probs among all three products in earliest projections, and new lightning probs are much higher than old lightning probs 5 hours and beyond.
- 7. 2011/05/24** – Explosive convection and lightning development from N TX to NE beginning near 6pm, which is predicted much better by new lightning (and convection) than old lightning.
- 8. 2011/05/25** – Explosive convection and lightning development from AR to OH beginning near 6 pm is repeated (as for previous day), which is very well captured by convection and new lightning products (old lightning products missing). Tendency to miss convection and lightning development along southwest flank of squall line is evident in southeast TX.

# Features in Cases (cont)

- 8. 2011/07/28** -- During 7 am to 6 pm period, convection probs are much higher than lightning probs in eastern US; convection and lightning probs are more similar to one another in mountainous southwestern US during 6 – 10 pm. New lightning (and convection) is better spatially focused than old lightning to capture development of line of convection from western KS to southern Lake Michigan at the longest projections.
- 9. 2011/07/31** – Typical mid-summer case, which features little predicted and observed convection before 12 noon, rapid predicted and observed convection/lightning beginning near 2 pm in SE and SW US, but peak convection probs are more elevated over peak lightning probs in the SE US than for SW US. The latter feature, which is quite typical of summer cases, is due to a combination of physical and radar data quality factors.
- 10. 2011/09/04** – This late summer case, which features Tropical Storm Lee coming ashore along the northern Gulf coastline, is typical for tropical storms in that convection probs are very high and lightning probs are quite low; this diverse prob combination is typical of tropical storms as heavy convective rain is accompanied by little or no lightning.



# Features in Cases (cont)

**11.2011/09/14** – Another late summer case, which is notable in that new lightning probs show better spatial focus than old lightning probs. This feature, which is more apparent during summer than during winter or spring months, which is likely due to NAM MOS predictor input in the new lightning probs.

# **Basic Findings from Examination of Cases**

- 1. Convection and lightning products should be used together**
- 2. Converting from prob to potential aids interpretation of the probs**
- 3. New lightning potential is more useful than old lightning yes/no categorical**
- 4. Convection-lightning potential combo provides easy discrimination of convection forecasts with and without lightning**
- 5. Convection-lightning combo distinguishes “tropical” from “extra-tropical” convection**
- 6. Convection and lightning forecasts are most different from one another during winter months ...most similar during summer**
- 7. Convection and lightning forecasts during warm season perform best around 22z (worst near 16z)**

# **Detailed Findings from Examination of Cases**

- 1. New lightning and old lightning probs are quite similar for very short projections**
- 2. Peak new lightning probs are generally higher than peak old lightning probs beyond very short projections**
- 3. New lightning prob maps have better spatial detail and focus than old lightning probs, especially during summer**
- 4. Peak lightning probs approach peak convection probs for mountainous western states during summer**
- 5. Some tendency to miss rapid, fine scale lightning development along southern or western flank of squall lines**



